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Patent
Attorney's Docket No. 040020-153

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

UTILITY PATENT
APPLICATION TRANSMITTAL LETTER

Box PATENT APPLICATION

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Enclosed for filing is the utility patent application of Tony KRSTANOVSKI, Hans RÖNNEKE, Hans-Olof SUNDELL and Klas HJELMGREN for Method, Apparatus, and System for Enabling Communication Between Second Generation and Third Generation Packet Data Networks.

Also enclosed are:

- [X] 5 sheet(s) of [] formal [X] informal drawing(s);
- [X] a claim for priority under 35 U.S.C. §§ 119 and/or 365 [X] is hereby made to Application No. 60/152,748 filed in The United States of America on September 8, 1999;
- [X] in the declaration;
- [X] An unexecuted declaration of the inventor(s) also is enclosed.

The filing fee has been calculated as follows:

CLAIMS					
	NO. OF CLAIMS		EXTRA CLAIMS	RATE	FEE
Basic Application Fee (101)					\$ 690.00
Total Claims	15	MINUS 20 =	0	x \$18 = (103)	.00
Independent Claims	3	MINUS 3 =	0	x \$78 = (102)	.00
If multiple dependent claims are presented, add \$260.00 (104)					.00
Total Application Fee					\$690.00
If verified statement claiming small entity status is enclosed, subtract 50% of Total Application Fee					.00
Add Assignment Recording Fee of \$40.00 (581) if Assignment document is enclosed					.00
TOTAL APPLICATION FEE DUE					\$690.00



21839

- ☐ This application is being filed without a filing fee. Issuance of a Notice to File Missing Parts of Application is respectfully requested.
- ☐ A check in the amount of \$_____ is enclosed for the fee due.
- ☒ Charge \$ 690.00 to Deposit Account No. 02-4800 for the fee due.
- ☒ The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17 and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800. This paper is submitted in duplicate.

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**METHOD, APPARATUS, AND SYSTEM FOR ENABLING COMMUNICATION
BETWEEN SECOND GENERATION AND THIRD GENERATION
PACKET DATA NETWORKS**

BACKGROUND

5 This application claims priority from U.S. Provisional Patent Application
No. 60/152,748, which was filed on September 8, 1999, and which is expressly
incorporated here by reference.

This invention relates generally to a method, apparatus, and system for enabling
communication between networks. More particularly, this invention relates to a method,
10 apparatus and system and method for enabling communication between second
generation and third generation packet data networks.

There are many types of public land mobile networks (PLMNs), e.g., a Global
System for Mobile Communications (GSM), a Digital Cellular System for Mobile
Communications (DCS 1800), and a Personal Communication System (PCS). These
15 networks provide a wide range of services and facilities to mobile subscribers that are
roaming around between individual cells of the mobile radio communication networks.
These networks support circuit-switched communication.

Global Packet Radio Service (GPRS) has been developed to support packet-
switched communication. GPRS is supported in second generation systems, e.g., second
20 generation GSM systems.

A Universal Mobile Telecommunications System (UMTS) is currently being
standardized within the 3rd Generation Partnership Project (3GPP), which is a cross-
regional cooperative project to develop a third generation standard which can be accepted
in as many regions of the world as possible. The UMTS will build on the success of the
25 GSM system.

The UMTS will support both circuit-switched data communication and packet-
switched communication. Thus, the UMTS will be useful for exchanging voice and non-
voice data quickly and efficiently.

FIG. 1 illustrates an exemplary network supporting circuit-switched and packet-

switched communication. In FIG. 1, a mobile station (MS) communicates with one or more Public Land Mobile Networks (PLMNs). A first network (PLMN1) is considered the Home PLMN (HPLMN) and includes a Home Location Register (HLR) containing subscriber data for subscribers to the network. The HPLMN also includes a Gateway GPRS Support Node (GGSN) for enabling packet-switched communication. PLMN2 and PLMN3 are considered visiting PLMNs. Each PLMN, other than the HPLMN, includes one or more Mobile Switching Centers (MSCs) for performing circuit switching for the mobile station and one or more Visitor Location Registers (VLRs) for storing data regarding subscribers to other networks that may be roaming in the network. The PLMNs also include Serving GPRS Support Nodes (SGSNs) for supporting packet-switched communication.

The HLR of PLMN1 communicates with VLR1, VLR2, and VLR3 for updating subscriber information, e.g., when a subscriber roams into an area served by one of these VLRs. The VLRs also communicate with each other.

The SGSNs are at the same hierarchical level in the network as the MSC/VLRs and function in a similar manner as the VLRs, but for packet-switched communication. The SGSNs keep track of the location of the GPRS user, perform security functions, and handle access control. The SGSNs communicate with the HLR to obtain subscriber profiles. The SGSNs also communicate with each other, and the SGSN of PLMN3 communicates with the base station subsystem (BSS) which, in turn, communicates with the MSC connected to VLR2 and with the MS.

The GGSN is the interconnection point for packet data between the GPRS network and the public data network. The GGSN is connected to the SGSNs via an Internet Protocol (IP) backbone. User data, e.g., from a GPRS terminal to the Internet, is sent encapsulated over the IP Backbone.

To accomplish roaming between GPRS and UMTS packet data networks, signaling between the networks and forwarding of user data are required. However, the network architectures for GPRS and UMTS networks are different, thus making interaction between the networks difficult.

In a second generation GPRS network, communication is performed node to node, as shown in FIG. 2. Second generation GPRS support nodes (2G-GSNs), e.g., GGSNs and SGSNs, communicate with each other using a GPRS tunneling protocol (GTP) described in, e.g., "GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface",
5 GSM 09.60 ver. 6.7.0 release 1997, Draft ETSI EN 301 347 v6.7.0 (July 2000).

In a third generation UMTS network, communication is performed in two different planes, as shown in FIG. 3. In FIG. 3, third generation GSN (3G-GSN) servers communicate with each other using a GPRS tunneling control protocol (GTP-C), and the 3G-GSN gateways also communicate with each other using a GPRS tunneling user
10 protocol (GTP-U). The 3G-GSN gateways also communicate with the 3G-GSN servers using a gateway control protocol (GCP). The 3G-GSN gateways and servers may be GGSNs and/or SGSNs.

Problems occur when a second generation GPRS node (2G-GSN) attempts to interact with a third generation UMTS node (3G-GSN) because the 2G-GSN nodes and
15 the 3G-GSN nodes support different kinds of protocols. As shown in FIG. 4, the GTP used for communication between 2G-GSN nodes tunnels both user and control data, while the GTP-C used for communicating between 3G-GSN servers tunnels only control data, and the GTP-U used for communicating between 3G-GSN gateways tunnels only user data. There is no protocol by which the 2G-GSN can communicate with a 3G-GSN
20 server or a 3G-GSN gateway. Also, the GTP can only address one node, whereas the 3G-GSN Server and 3G-GSN Gateway are placed in two different nodes.

Currently, there is no provision permitting a 2G-GSN node to interact with the 3G-GSN server or a 3G-GSN gateway.

Thus, there is a need for a technique permitting 2G-GSNs to interact with
25 3G-GSN servers and 3G-GSN gateways to permit roaming between GPRS and UMTS networks.

SUMMARY

It is therefore an object of the invention to permit interaction of different networks

such as second generation GPRS and third generation UMTS networks. It is a further object of the invention to permit roaming of a subscriber between different networks.

According to exemplary embodiments, these and other objects are achieved by a method, apparatus and system for communicating between a first network in which
5 control functions and user functions are combined in a first node and a second network in which user functions are implemented in a second node, and control functions are implemented in a third node. A determination is made whether data received includes control data. If so, control data is extracted from the data and forwarded to the third
10 node. The control data is used for resource handling. The extraction and forwarding may be performed in the first, second, or third node or at any place in between. If the received data does not contain control data, control data is added at the third node and forwarded to the second node. The first network may be a second generation data packet network, e.g., a Global Packet Radio Service (GPRS) network, and the second network may be a
15 third generation packet data network., e.g., a Universal Mobile Telecommunication System (UMTS) network.

BRIEF DESCRIPTION OF THE DRAWINGS

The features, objects, and advantages of the invention will become apparent by reading this description in conjunction with the accompanying drawings, in which like
20 reference numerals refer to like elements and in which:

FIG. 1 illustrates an exemplary network supporting circuit-switched and packet-switched communication;

FIG. 2 illustrates an exemplary second generation GPRS communication architecture;

FIG. 3 illustrates an exemplary third generation UMTS communication architecture;

FIG. 4 illustrates a problem encountered when attempting to interact between UMTS and GPRS networks;

FIGS. 5A and 5B illustrate exemplary systems for communicating between a

second generation GPRS network and a third generation UMTS network;

FIG. 6 illustrates a GTP header; and

FIG. 7 illustrates a method for communicating between a second generation GPRS network and a third generation UMTS network.

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DETAILED DESCRIPTION

The following describes exemplary embodiments of methods and apparatus that enable different networks to communicate with each other. Communication is made possible by using a protocol splitter to separate user data and control data.

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FIGS. 5A and 5B illustrate exemplary systems for enabling communication between a second generation network and a third generation network.

In FIG. 5A, communication in the direction from the 2G-GSN node to the 3G-GSN gateway is shown, while in FIG. 5B, communication in the direction of the 3G-GSN gateway to the 2G-GSN is shown.

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Referring to FIG. 5A, when control data is transferred from a 2G-GSN node to the 3G-GSN gateway, a GTP protocol splitter extracts the control data from the GTP tunnel and sends it to the 3G-GSN server. In FIG. 5A, the GTP protocol splitter is included in the 3G-GSN gateway. The 3G-GSN gateway processes the user data from the 2G-GSN node as if it were a 2G-GSN. The 3G-GSN server processes the control data, and resource handling is performed using a control protocol, e.g., a gateway control protocol (GCP), in a server-gateway control loop. Resource handling is a function implemented in a 3G-GSN server that checks that there is enough resources in terms of hard disk and CPU memory space before allowing a user to attach to the server. If there are no resources left, the user will be denied access to the server. It will be appreciated that many forms of GCP may be used, e.g., H.248, XCP, or Internet Engineering Task Force (IETF) MEGACO.

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To distinguish between control data and user data in the data received at the protocol splitter functionality in the 3G-GSN gateway, two fields are provided in the GTP header in each packet: a version number field, and a message type field. The version

number field may be bits 6-8 in octet 1 of the GTP header as described in GSM 09.60, ver. 6.7.0 (which was cited above and is expressly incorporated here by reference). A value 0 in the version number field advantageously corresponds to the GTP, and other values may be used to indicate other versions of GTP, e.g., a protocol in which control data and user data are integrated. The message type field in the GTP header indicates whether the GTP packet is a control message or user data. The message type field may be octet 2 of the GTP header and preferably has a predetermined value, e.g., 255 (in decimal), for user data packages, and other values indicate control data packages.

FIG. 6 is an outline of a GTP header that includes twenty octets, including the version number and message type fields described above, and several other fields, including a number of spare 1 bits, a flag SNN, a length indicating the length in octets of the GTP message, a sequence number that is a transaction identity for signaling messages and an increasing sequence number for tunnelled original packets (i.e., the payload tunnelled in the GTP tunnel), a flow label that unambiguously identifies a GTP flow, a tunnel identifier (TID). It will be appreciated that FIG. 6 depicts only one of many configurations of GTP header that can be used.

The GTP protocol splitter functionality, together with the server-gateway control loop, enables communication between a GPRS traditional network architecture and an UMTS server-gateway network architecture. Advantageously, all interfaces conform to applicable standards.

Control signaling in the opposite direction, i.e., from the 3G-GSN network to the 2G-GSN network, is simpler, as illustrated by FIG. 5B. The 3G-GSN server sends GTP-C messages to the 3G-GSN gateway, which converts them to GTP and forwards them to the 2G-GSN node. A command on the GTP-C link to the 3G-GSN server from the GTP-splitter, e.g., in the 3G-GSN gateway, results in a new command on the GCP link back to the 3G-GSN gateway.

An event in the 3G-GSN gateway, triggered by, e.g., an incoming GTP control packet as in FIG. 5B, triggers a GCP-notification to be sent to the 3G-GSN server. The 3G-GSN server then sends GTP-C packets to the 3G-GSN gateway, which converts them

to GTP packets and forwards them to the 2G-GSN node.

By implementing the GTP protocol splitter and a server-gateway control loop in the 3G-GSN gateway, full integration with the second generation GPRS network is made possible. The GTP protocol splitter may be implemented in a 3G-GSN gateway. The user traffic is processed inside the 3G-GSN gateway, and the control traffic is forwarded to and from the corresponding 3G-GSN server. Therefore, no additional protocols are required for the server. Also, the network operator does not require additional equipment to make the UMTS network interact with GPRS. The converter enables the operator to introduce UMTS in a limited area without affecting the 2G-GSN nodes. Communication between traditional network architecture and a server-gateway architecture is enabled, and the IP address problem when these architectures communication is solved. Traditional combined nodes (2G-GSN) do not need to be upgraded to communicate with server-gateway nodes (3G-GSN).

The 3G-GSN gateway acts as a 2G-SGSN node for uplink communication, i.e., for traffic from a 3G-SGSN gateway to a 2G-SGSN node. However, the downlink traffic is also made possible, e.g., when the 2G-GSN node is a GPRS GGSN. In such a case, for downlink traffic, the GTP still go to the 3G-GSN gateway, but the 3G-GSN gateway acts as a 2G-SGSN.

Although described above as being located in the 3G-GSN gateway, the GTP protocol splitter may be physically located in a separate box or node. In terms of hardware, the GTP splitter can be implemented in an integrated circuit, such as a field programmable gate array (FPGA) or other application specific integrated circuit (ASIC), mounted on a printed circuit board, which preferably is an already existing interface board in the node.

FIG. 7 illustrates an exemplary method for communicating between different networks. The method begins at step 700 at which a determination is made whether data received at the protocol splitter contains control data by detecting the GTP header. If the received data contains control data, the control data is separated from the received data at step 710 and forwarded to the 3G-GSN server at step 720. The 3G-GSN server then

transmits commands for resource handling to the 3G-GSN gateway via the GCP at steps 730-760. If, at step 700, it is determined that the received data does not contain control data, the 3G-GSN gateway simply processes the packet and forwards it to the 2G-GSN in step 770.

- 5 It will be appreciated by those of ordinary skill in the art that this invention can be embodied in other specific forms without departing from its essential character. The embodiments described above should therefore be considered in all respects to be illustrative and not restrictive.

WE CLAIM:

1. A method for enabling communication between a first network in which control functions and user functions are combined in a first node and a second network in which user functions and control functions are separately implemented in second and
5 third nodes, respectively, the method comprising the steps of:
determining whether received data contains control data; and
if the received data contains control data, extracting control data from the received data and forwarding the control data to the third node for resource handling.
2. The method of claim 1, wherein if the received data does not contain
10 control data, the received data is processed by the second node and then forwarded to the first node.
3. The method of claim 1, wherein the steps of extracting and forwarding are performed in the second node.
4. The method of claim 1, wherein the first network is a second generation
15 packet data network, and the second network is a third generation packet data network.
5. The method of claim 4, wherein the first network is a second generation Global Packet Radio Service (GPRS) network, and the second network is a third generation Universal Mobile Telecommunication System (UMTS) network.
6. An apparatus for enabling communication between a first network in
20 which control functions and user functions are combined in a first node and a second network in which control functions and user functions are separately implemented in second and third nodes, respectively, the apparatus comprising:
a detector for detecting whether received data contains control data;
a protocol device for extracting control data from the received data and
25 forwarding the control data to the third node for resource handling, if the detector determines that the received data contains control data.
7. The apparatus of claim 6, wherein if the received data does not contain control data, the received data is forwarded by the third node to the first node.
8. The apparatus of claim 6, wherein the device is included in third node.

9. The apparatus of claim 6, wherein the first network is a second generation packet data network, and the second network is a third generation packet data network.

10. The apparatus of claim 9, wherein the first network is a second generation Global Packet Radio Service (GPRS) network, and the second network is a third generation Universal Mobile Telecommunication System (UMTS) network.

11. A system for enabling communication between a first network in which control functions and user functions are combined in the same node and another network in which user functions and control function are implemented in separate nodes, the system comprising:

a first node in the first network, wherein user functions and control functions are handled in the first node;

a second node in the second network wherein user functions are handled in the second node;

a third node in the second network wherein control functions are handled in the third node; and

a device for determining whether received data contains control data, and, if received data contains control data, extracting control data from the received data and forwarding the control data to the third node.

12. The system of claim 11, wherein if the third node wants to forward control data to the first node, the third node first forwards the control data to the second node, which converts the control data to GTP and forwards the GTP control data to the first node.

13. The system of claim 11, wherein the device is included in the second node.

14. The system of claim 11, wherein the first network is a second generation packet data network, and the second network is a third generation packet data network.

15. The system of claim 14, wherein the first network is a second generation Global Packet Radio Service (GPRS) network, and the second network is a third generation Universal Mobile Telecommunication System (UMTS) network.

ABSTRACT

Communication is enabled between a first network in which control functions and user functions are combined in a first node and a second network in which user functions are implemented in a second node, and control functions are implemented in a third node.

5 A determination is made whether data received contains control data. If so the control data is extracted from the received data and is forwarded to the third node in which control functions are handled. The control data is used for resource handling. The extraction and forwarding may be performed in the first, second, or third node or at any place in between. If the received data does not contain control data, control data is added
10 at the third node and forwarded to the second node. The first network may be a second generation data packet network, e.g., a Global Packet Radio Service (GPRS) network, and the second network may be a third generation packet data network, e.g., a Universal Mobile Telecommunication System (UMTS) network.

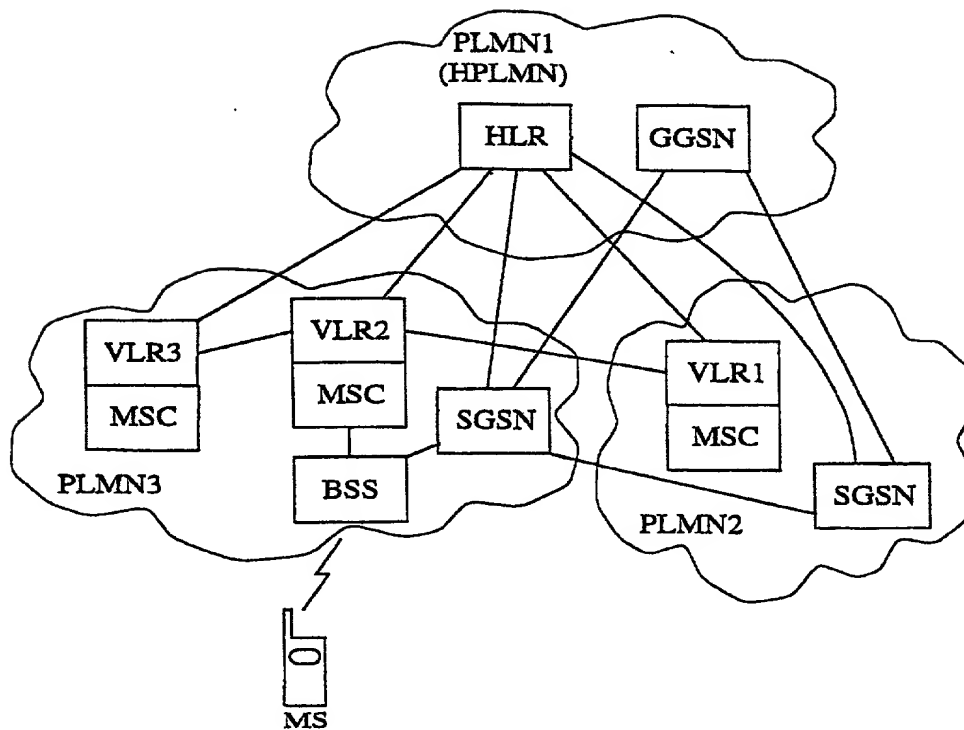


FIG. 1

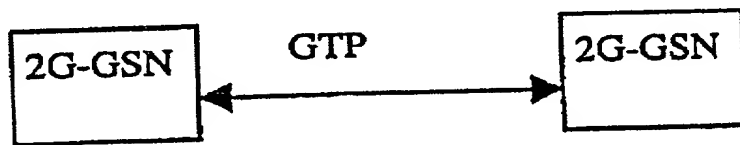


FIG. 2

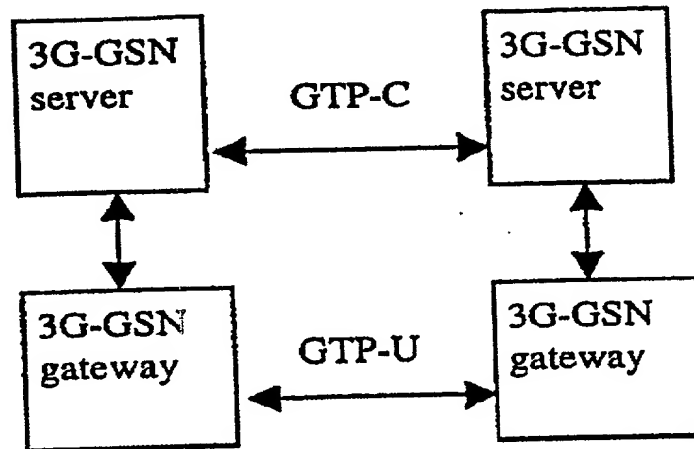


FIG. 3

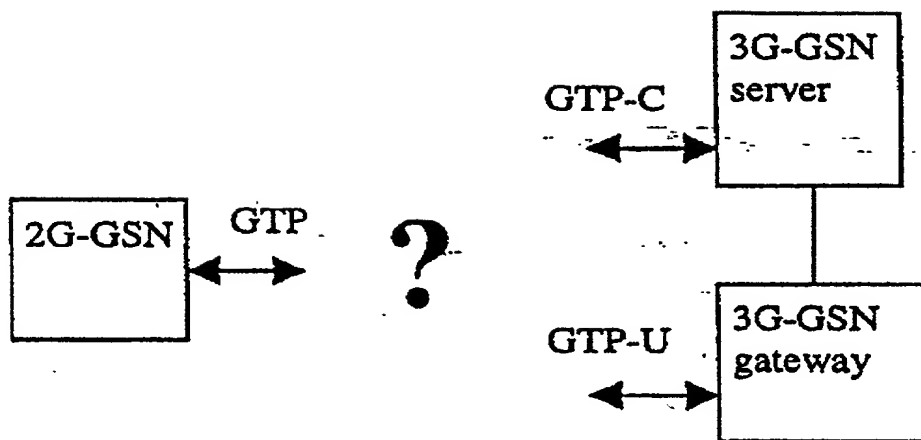


FIG. 4

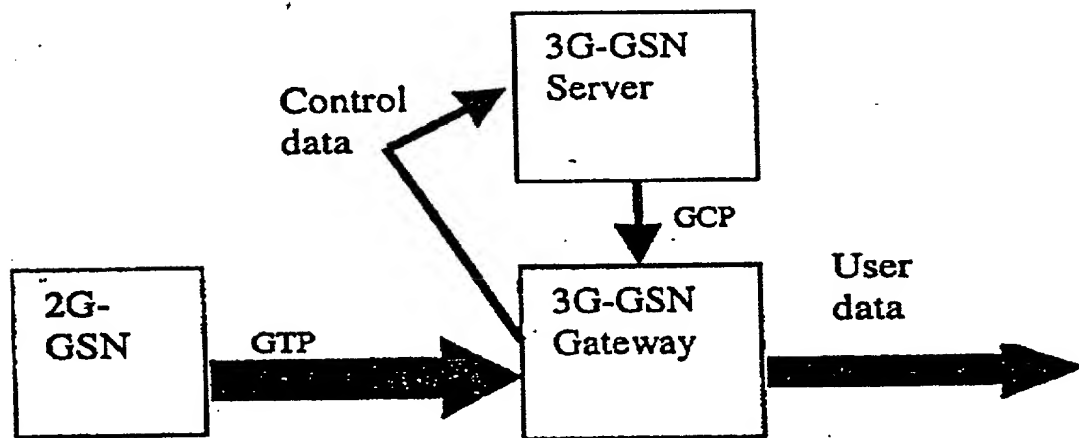


FIG. 5A

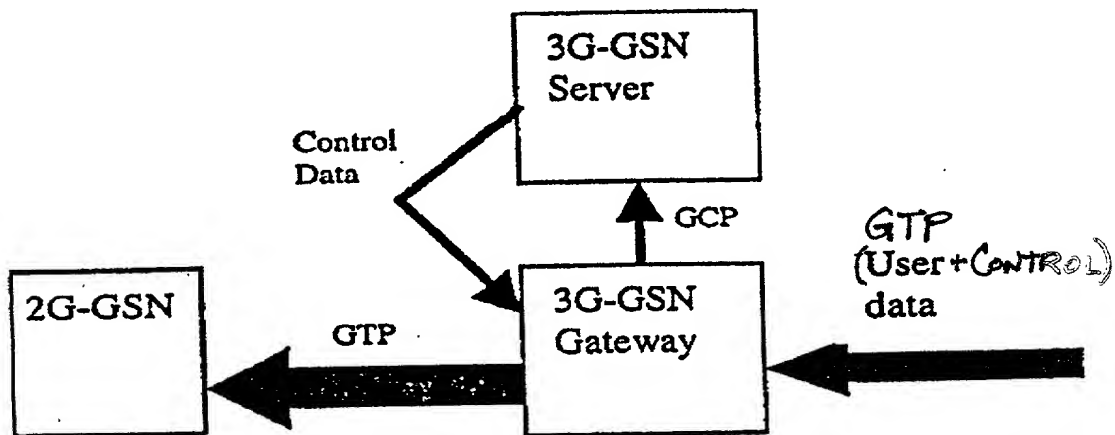


FIG. 5B

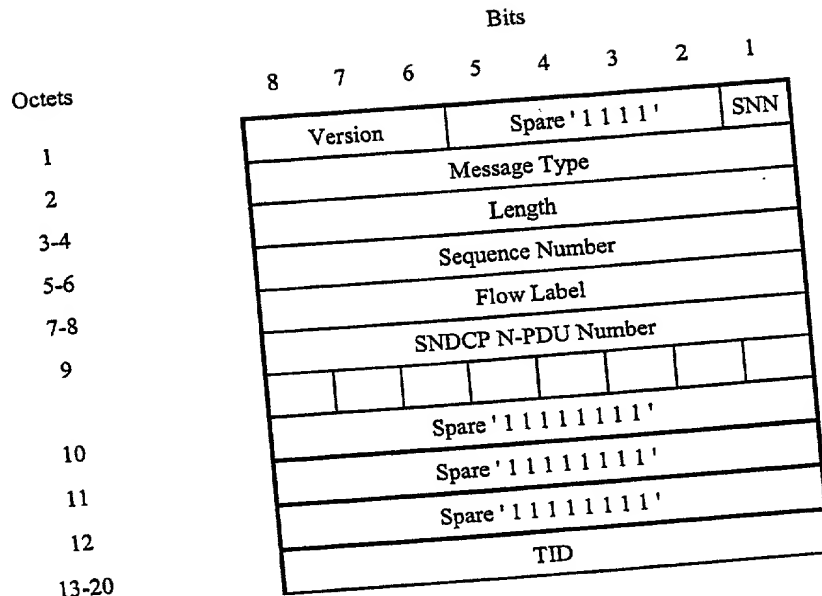


FIG. 6

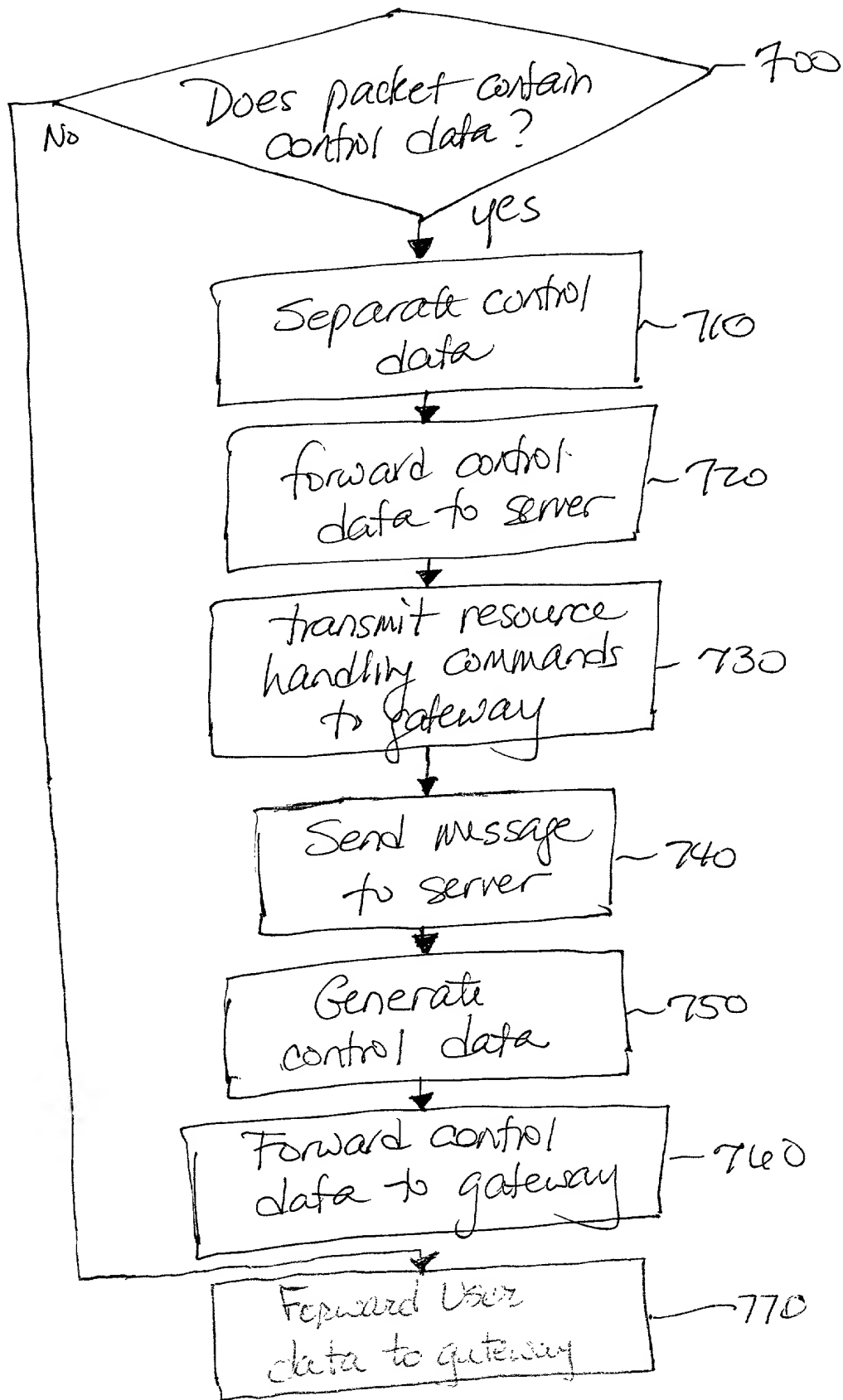


FIG. 7

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
(Includes Reference to Provisional and PCT International Applications)

ATTORNEY'S DOCKET NUMBER

040020-153

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Method, Apparatus, and System for Enabling Communication Between Second Generation
and Third Generation Packet Data Networks

the specification of which (check only one item below):

☒ is attached hereto.

☐ was filed as United States application

Number _____

on _____

and was amended

on _____ (if applicable).

☐ was filed as PCT international application

Number _____

on _____

and was amended under PCT Article 19 and/or PCT Article 34

on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §§ 119 (a)-(e) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119:

COUNTRY (if PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. § 119
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			<input type="checkbox"/> Yes <input type="checkbox"/> No

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

60/152,748

(Application Number)

September 8, 1999

(Filing Date)

(Application Number)

(Filing Date)

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (CONTINUED)
(Includes Reference to Provisional and PCT International Applications)

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040020-153

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose to the Office all information known to me to be material to the patentability as defined in Title 37, Code of Federal Regulations § 1.56, which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. § 120:

U.S. APPLICATIONS

STATUS (check one)

U.S. APPLICATION NUMBER

U.S. FILING DATE

PATENTED

PENDING

ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.

PCT APPLICATION NO.

PCT FILING DATE

U.S. APPLICATION NUMBERS
ASSIGNED (if any)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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(Includes Reference to Provisional and PCT International Applications)

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040020-153

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POST OFFICE ADDRESS				
Hagåkersgatan 4D, S-431 41 Mölndal, Sweden				
FULL NAME OF SECOND JOINT INVENTOR, IF ANY		SIGNATURE		DATE
Hans RÖNNEKE				
RESIDENCE		CITIZENSHIP		
Kungsbacka, Sweden		Swedish		
POST OFFICE ADDRESS				
Källasgårdsgatan 18, S-434 36 Kungsbacka, Sweden				
FULL NAME OF THIRD JOINT INVENTOR, IF ANY		SIGNATURE		DATE
Hans-Olof SUNDELL				
RESIDENCE		CITIZENSHIP		
Öckerö, Sweden		Swedish		
POST OFFICE ADDRESS				
Box 17 Kalvsund, S-430 90 Öckerö, Sweden				
FULL NAME OF FOURTH JOINT INVENTOR, IF ANY		SIGNATURE		DATE
Klas HJELMGREN				
RESIDENCE		CITIZENSHIP		
Göteborg, Sweden		Swedish		
POST OFFICE ADDRESS				
Erik Dahlbergsgatan 19, S-411 26 Göteborg, Sweden				
FULL NAME OF FIFTH JOINT INVENTOR, IF ANY		SIGNATURE		DATE
RESIDENCE		CITIZENSHIP		
POST OFFICE ADDRESS				
FULL NAME OF SIXTH JOINT INVENTOR, IF ANY		SIGNATURE		DATE
RESIDENCE		CITIZENSHIP		
POST OFFICE ADDRESS				
FULL NAME OF SEVENTH JOINT INVENTOR, IF ANY		SIGNATURE		DATE
RESIDENCE		CITIZENSHIP		
POST OFFICE ADDRESS				
FULL NAME OF EIGHTH JOINT INVENTOR, IF ANY		SIGNATURE		DATE
RESIDENCE		CITIZENSHIP		
POST OFFICE ADDRESS				
FULL NAME OF NINTH JOINT INVENTOR, IF ANY		SIGNATURE		DATE
RESIDENCE		CITIZENSHIP		
POST OFFICE ADDRESS				